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SURGERY OF THE PANCREAS.[1]

WITH ESPECIAL CONSIDERATION OF TRAUMA AND INFLAMMATORY PROCESSES.

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OPERATIVE interference for disease of the pancreas is still at the present time the most incomplete chapter in the realm of abdominal surgery. It is scarcely twenty years since Gussenbauer described the first operation for cysts of the pancreas. For many years the surgery of this organ was confined to the treatment of this affection, which was a comparatively easy task so far as the technique was concerned. In regard to the other pancreatic affections, as trauma, inflammatory conditions, and new growths in the narrowest sense of the word, it is only in the last ten years that surgical treatment has been seriously undertaken. So recently as 1891 and 1892, the anatomists von Gerlach and Joessel dismissed the subject of the topographical anatomy of the pancreas in a few words, stating that the organ had no clinical interest, as it was almost impossible for the surgeon to reach it.

Still another difficulty presents itself to the surgeon who reports on affections of this organ. When we make an exception of the cystic condition, it is very seldom that one, with our present knowledge, has an opportunity to operate upon the diseased pancreas. Hence, the personal experience of each surgeon is only small, and a comprehensive report must rest in a great measure upon the observations of others. When I look over the notes of my own cases of pancreatic surgery during the last twelve years, I find that there are about sixty. This considerable total for a single surgeon is, however, materially reduced when I exclude thirty cases in which malignant disease of the stomach, for which I did resections, had involved the pancreas. However, the observations made in these cases are not without importance to our subject, and I shall refer to them later.

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When we seek the cause of the tardy development of the surgery of the pancreas, we find we can ascribe it principally to three general reasons which we must consider carefully, as they show us that which we may expect from this branch of surgery in the future.

First, the topographical relations of the organ should be considered. The hidden and protected position of the pancreas accounts for the infrequency with which it is injured. When such, however, is the case, there usually exist severe complicating injuries of neighboring organs, and the patient very often dies either from shock or from hæmorrhage before the surgeon has the opportunity to interfere. But when the abdomen is opened in such cases, the accompanying injuries of the surrounding parts almost always demand such attention that the lesion of the pancreas is easily overlooked. Its protected position makes the technique of bringing it, or portions of it, to the surface of the body exceedingly difficult when no changes from disease are present which approximate the organ to the abdominal walls, for example, in pancreatic cysts. We possess, therefore, no such typical operative methods like those which we employ in exposing the kidney, gall-bladder, or vermiform appendix, whereby the pancreas can be made accessible, and which would be looked upon as normal methods. According to the location of the diseased part and to the enlargement of the organ in a certain direction, we are compelled to reach the pancreas by various routes, and in this we are, moreover, hindered by the interposition of many organs that surround it.

The operative methods by which we can expose the pancreas may be divided into two general groups: first, the transperitoneal, and second, the retroperitoneal.

In the transperitoneal methods, one enters through a median or lateral incision in the anterior abdominal wall, and then either through the gastrocolic ligament, the ligamentum gastrohepaticum, or, after pushing up the omentum and transverse colon, through the mesocolon. In each case the omental bursa is opened. A fourth transperitoneal method (employed by Koerte) is to force one's way along the side of the duodenum, the peritoneal covering of which must first be incised. By this last method, of course, only the head of the pancreas can be conveniently exposed. The retroperitoneal methods aim to reach the pancreas by incisions in the lumbar region. By this means one is enabled to expose only the head or tail of the organ, and the method should therefore be employed only when through changes by disease the affected part is pushed farther to one side or is enlarged as in abscesses, cysts, or tumors.

Another difficulty which we have to contend with results from the location of the pancreas, owing to the possibility of severely injuring surrounding organs when we attempt to reach the pancreas. Besides the stomach and transverse colon, which lie in front of the pancreas, the common bile-duct, the duodenum, and the large blood-vessels demand attention; not less the middle colic artery, the injury of which is followed by gangrene of the transverse colon, a fact which Kroenlein has first demonstrated by his anatomical studies.

Another fact which has prevented the advancement of pancreatic surgery is the difficulty in diagnosis. Here, also, the concealed position of the organ is the main obstacle. The result of examination by palpation is often absolutely negative, in most cases indefinite, and, even when the organ is much enlarged and readily felt by the hand as the result of disease, the interpretation is usually uncertain.

The subjective symptoms are just as indefinite. I must not permit myself to discuss further the difficulties of diagnosis. I only wish to advance the statement that the surgeon cannot rely on the disturbance of function, in most cases, as a diagnostic sign of value. According to our experience, signs of functional disturbance in this enormously important organ do not appear until the greater portion of the gland is affected. Then the surgeon has no longer any right to interfere, for, when once a pancreatic diabetes or symptoms of severe disturbance of its fat-digesting function develop, the patient is, as a rule, beyond the help of operative measures. Experience, in fact, has shown that in affections of the pancreas, which have been treated surgically, positive functional disturbances have been observed only in rare instances. The surgeon cannot, unfortunately, watch the further course of the disease as the medical clinician does, but he must, on the contrary, decide upon the operation, particularly if it be a question of surgical interference, while the general condition of the patient is still satisfactory. So at the present time most cases are operated upon when the diagnosis is only probable, and only after the abdominal cavity has been opened can a differential diagnosis be made. As is well known, in the beginning of the era of pancreatic surgery, most operations were undertaken on a false diagnosis; to-day, as soon as an affection of the pancreas is deemed probable, it is considered wise to submit the patient to an exploratory laparotomy. This practice, fortunately, is of no great consequence, because, as a rule, when the pancreas is intact, we find other injuries or diseases present which justify laparotomy.

A third reason which has prevented the rapid development of pancreatic surgery is that the operation, so far as it includes the organ itself, is much more dangerous than an operation upon any other abdominal organ. This is partly the result of the fact that in most diseases of the pancreas, with the exception of cysts, the general condition of the patient is so low that his recuperative powers are markedly diminished.

A further danger lies in the peculiar physiological character of the gland itself. Two points come into consideration here. The pancreas is very rich in blood-vessels, and hæmorrhage from an injury is difficult to control. Simple tying of the fragile tissues is insufficient, and one must stop the bleeding with sutures deeply buried in the tissues and including much of the latter, which has the disadvantage of causing the parenchyma to necrose, thereby creating conditions which will be shortly discussed.

In spite of deep sutures and heavy ligatures *en masse*, blood and pancreatic secretions ooze into the peritoneal cavity, preventing the formation of peritoneal adhesions, which in abdominal operations in general are so important a protection. Secondary hæmorrhage into the peritoneal cavity is very apt to occur. Several operations are recorded in medical literature which seemed to promise a favorable result, but which ended fatally from this complication.

A danger much greater than that from hæmorrhage complicating operations on the pancreas is that due to the special secretion of the gland leaking from the injured parenchyma in larger or smaller quantities. The point as to whether or not this leakage is injurious was only recently definitely settled. After the experiments and experiences of recent years, we can no longer doubt that such leakage is indeed harmful. The experimental studies of Williams, Flexner, Biondi, Katz and Winkler, and others, show clearly that injuries of the pancreas, through which the vitality of a part of the organ is impaired, and the flow of pancreatic juice towards the pancreatic duct is hindered or ceases entirely, seriously affect the peritoneum and the neighboring tissues. Fat necrosis, as well as the various forms of pancreatic inflammation, from a severe hæmorrhagic pancreatitis to a chronic induration, may be experimentally produced in animals by such injuries. A number of reliable clinical observations are on record, in which, after accidental injuries, changes were present in the pancreas and the neighboring organs similar to those which we have just considered in connection with the experimental work on this subject. When death does not ensue from hæmorrhage in such cases, a fatal result may occur from the acute, subacute, or chronic forms of pancreatitis following such injuries. I can mention in this direction the observations of Simmonds, Schmidt, Hahn, Gessner, Pressel, Seudler, Groeningen, Leith, Ziegler, and Selberg. Even after injury to the organ during operation, fat necrosis has been observed, as in Koester's case. That enormous quantities of pancreatic secretion can escape from the wound surfaces of the pancreas is proved by the interesting cases of Ruggi and Biondi, who resected a large portion of the pancreas for a malignant tumor and drained the wound.

How much worse the prognosis of an operation becomes when the pancreas has been injured is shown by my statistics of gastric resections in cases of cancer. In ninety-one cases of resection of the stomach where the pancreas was certainly not injured, twenty-five, or 27.5 per cent., died as the result of the operation. In thirty other cases the pancreas was injured. This was usually due merely to freeing the tumor from adhesions to the pancreas. The parenchyma of the pancreas, however, was exposed and communicated freely with the abdominal cavity. In other cases pancreatic lymph glands or superficial parts of the pancreas were removed. Of these thirty cases, twenty-one, or 70 per cent., died, mostly of peritonitis.*

If we ask ourselves whether the secretion from the injured pancreas leaking into the abdominal cavity can of itself so damage the peritoneum that death from this cause alone may result, we must surely admit that this is a possibility, as shown by a number of experiments and clinical observations of accidental injuries in man. The pancreatic juice mixed with blood has, no doubt, a very toxic effect and can, in the so-called apoplexy of the pancreas, result fatally without the complication of bacterial infection.

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* It might be said that the mortality of these thirty cases was high on account of the severity and length of the operation. This objection would be just, if the majority of cases had died in collapse, which was not the case. As already stated, the majority died of peritonitis.

In the majority of cases, the secretion from the pancreas —I do not refer to the normal physiological secretion, but rather to the exudate from the injured organ—does not flood the abdominal cavity in such quantities that it will prove fatal by mere absorption. It acts indirectly by reason of the local irritation of the peritoneum in that it prepares a nutrient medium for bacterial invasion and makes infection extremely easy.*

Even with the present status of our aseptic technique it is not possible to prevent all germs from reaching the abdominal cavity during laparotomy. An uninjured peritoneum will resist this infection if the germs are not introduced in certain quantities. But if the vitality of the peritoneum has been impaired by the action of the pancreatic secretions, then a very limited number of bacteria are sufficient to cause peritonitis.

There is also in every case of injury of the pancreas, the danger of a retrograde infection from the duodenum through the ductus pancreaticus. It seems, moreover, that the secretion from the injured, or also inflamed pancreas without bacterial invasion, can cause a variety of aseptic peritonitis. This is frequently followed by a paralysis of the intestines, leading to rapidly developing intestinal obstruction which often so modifies the symptoms as to lead to a serious mistake in diagnosis.

I speak of this point more in detail because I consider it of great importance in pancreatic surgery. For whatever operation may be done on the pancreas, we must take the greatest pains to keep the secretion of the injured gland from getting into the abdominal cavity. This can be done in two ways: first, one can turn the injured part inward and close it with deep sutures so that the peritoneal covering is again in continuity. Ninni used this method with good results in a gunshot wound. As a rule, however, this will not be possible, or, at least, will not offer a sufficient protection against leakage of the pancreatic juice into the peritoneal cavity. Nothing more can be done in these cases than to protect the latter by means of tampons reaching down to the exposed pancreas.

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* Not only the normal constituents of the pancreatic juice, chiefly pancreatin and steapsin, come into consideration, but also the direct degeneration products of the dead gland cells. The latter should not be confounded with the pancreatic secretion, as has apparently been done by a number of experimenters; for example, Senn decided, from his experiments in which he made an internal pancreatic fistula, that injuries of the pancreas are without special influence upon the abdominal cavity. It is not correct to assume that the juice of any crushed or powdered gland is identical with its normal secretion. A large number of investigators have observed that when the excretory duct of the pancreas is ligated, and retention of the glandular secretions results, the typical signs of fat necrosis of the pancreas do not appear. This is explained by the fact that the normal or nearly normal secretion is carried away in the lymph and blood stream, where its ferments are rendered harmless, as the investigations of von Nencki and Tschepurkowski have shown.

The value of this tampon drainage is demonstrated to-day by the limited number of wounds of the pancreas which have been operated upon. Of twelve injuries, partly the result of blunt force, of stab or gunshot wounds, eight were drained.* Of these six recovered and two died. Of the four undrained cases, three died, only the previously quoted case of Ninni recovering.

When capillary drainage of wounds of the otherwise healthy pancreas is so important, there can be no doubt of its greater value in operations upon the diseased organ. This obtains not only in acute and chronic inflammatory conditions due to bacterial infection, but also in certain aseptic lesions which present themselves to us clinically as pancreatic apoplexy in the most acute cases, or in the more chronic as pancreatic cysts. The admixture of blood to the pancreatic secretion in the peritoneal cavity renders the condition more serious. We see, therefore, that when patients survive the acute stage of the disease, whether septic or aseptic, this is accomplished only through the walling off of the focus of disease by peritoneal adhesions.*

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* These are the cases of Hahn, Deutsche Zeitschrift für Chirurgie, Band lviii, 1901. Küttner, Beiträge zur klinischen Chirurgie, Band xxxii. Villiere, Bulletin de la Société Anatomique de Paris, Band lxx, 1895. Rose, Deutsche Zeitschrift für Chirurgie, Band xxxiv, 3, 36. Hadra, New York Medical Record, 1896. Von Mikulicz, Vierteljahr-Schrift für gerichtliche Medicin (3), xviii, 2. Michaux, XIII Internationale Medicinischer Kongress zu Paris. Cushing, ANNALS OF SURGERY, p. 69 (1898), page 337.

I have attempted to collect all operations for acute disease of the pancreas to determine, if possible, the value of drainage also in such cases. I have succeeded in finding thirty cases. In twenty-seven of these, it is distinctly stated that the exposed pancreas was drained; of these, eleven, or 38 per cent., died. In the remaining number, either no drainage was established, or exact statements are lacking. Of these, forty-one, or 80 per cent., died.†

From these statistics, we should conclude that wherever the pancreatic tissue has been exposed at all, the abdominal cavity must be tamponed, and drainage established.

After these general remarks, we will proceed to the special part of our subject. We can divide pancreatic diseases which concern the surgeon into three great groups: (1) Injuries; (2) inflammatory processes; and (3) new growths.

In the second group I would include also pancreatic apoplexy and pancreatic calculi; in the third group we will place in addition to tumors, as is generally customary, the pancreatic cysts which, although in a great number of cases of traumatic origin, in others are certainly due to small apoplexies or to an inflammatory condition.

As I have repeatedly spoken of the injuries of the pancreas, I can now be more brief, particularly as the number of cases on record is even, at the present time, very small. The problem presented to the surgeon by an injury of the pancreas to-day is very clear. We have first to stop the hæmorrhage, and secondly, to prevent, as much as possible, the flow of pancreatic secretion into the abdominal cavity and the subperitoneal tissues. The first and, to some extent, the second problem will be solved by deep sutures and ligatures *en masse*. Where a break in the continuity of the organ through a stab or gunshot wound occurs, we close the wound with deep sutures, and thereby best control the bleeding and leakage of pancreatic secretions. When the pancreas, as usually happens by the action of blunt force, is not simply torn but crushed, these means will not be sufficient.

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* Recently Pierre Achalme has made experimental studies on the action of pancreatin in the peritoneal cavity. He tried to discover whether the blood serum of the animal experimented upon did not possess some anti-fermentative virtue, and if it could produce immunity when given in increasing doses. He was not only successful in rendering animals thus treated immune against toxic doses of pancreatin, but also in obtaining a serum that immunized other animals. Perhaps a serum acting similarly on human beings might be obtained. This would enable us to protect the patient to be operated upon against the harmful effect resulting from absorption of his own pancreatic secretions.

† In the last category, it is possible that a number of drained cases are included, and therefore the resulting mortality turns out too favorable.

Here, as in all unsutured wounds of the pancreas, we must of necessity use the tampon to overcome the dangers previously discussed. Even when the wound is sewed, tamponing is to be recommended, especially when neighboring portions of the stomach or intestines are injured, this being a frequent complication. In spite of prompt suturing of wounds of the stomach and intestine, the danger of peritonitis is very great.

The diagnosis of these cases can rarely be made with any degree of certainty. The difficulties which we contend with in this respect are so great owing to the fact that in most cases the neighboring organs are also injured. In cases which come under observation very soon after injury, we can only suspect a lesion of the pancreas. The surgeon must, however, always bear in mind the possibility of injury to the pancreas in all cases where the force has acted upon the epigastric and umbilical region. He must always direct his attention to the pancreas if, after opening the abdomen, he finds a lesion of another organ, such as the stomach. We often find cases reported where, wounds of the stomach or intestines having been sutured, death has occurred from an undetected wound of the pancreas.

With the uncertainty of diagnosis it is best to make the incision, as a rule, in the median line above the umbilicus. This is also true for penetrating wounds which lie some distance from the median line. From this median incision one can best determine what changes are present in the peritoneal cavity, and can enlarge the incision above, below, or to one side, as needed, exposing the injured pancreas according to the location of the injury. Then we can proceed as in wounds of other abdominal organs. I want, in this connection, to mention the great importance of thoroughly washing out the peritoneal cavity with warm normal salt solution (0.9 per cent.).

I have found in all forty-five cases of pancreatic injury, twenty-one penetrating wounds and twenty-four subcutaneous wounds from blunt force. Of the twenty-one penetrating wounds, twelve were of gunshot origin and nine were stab wounds. Of the gunshot wounds, five were operated upon, two dying and three recovering. (The cases of Otis, Hahn, and Nimi.) The seven that were not operated upon died. The nine stab wounds were all operated upon, one dying and eight recovering. This remarkably favorable percentage of recovery in the stab wounds is to be explained by the fact that, in seven cases, the pancreatic injury was really a prolapse, and in some of these cases only a very minor lesion of the prolapsed portion was present. The evil consequences of injuries to the pancreas within the peritoneal cavity could therefore not follow. The operation in seven cases of pancreatic prolapse consisted in excision of the dislocated portion in five cases and reposition in the other two cases. An intra-abdominal punctured wound of the pancreas occurred only in the cases of Hildebrand and Küttner. In the latter recently published case, the organ was almost completely divided in an anteroposterior direction. Küttner united the divided pancreas by means of two deep and one superficial suture; the hæmorrhage stopped at once; then a wound in the stomach, nine centimetres long, was sewed up, and finally the omental bursa was drained with a tampon. The case recovered, even though it was complicated by the formation of a subphrenic abscess.

In Hildebrand's case there was also a perforation of the stomach in addition to the injury to the pancreas. The wound in the stomach was sutured and the bleeding vessels of the pancreas were ligated. No drainage was established, and the patient died four days after laparotomy.

Of the twenty-four subcutaneous injuries, thirteen were not operated upon and all died. Of the eleven operated on, seven recovered. Three cases were operated upon early, within four days after the injury. One of these recovered (Hadra) and two died (Villiere, Michaux).

The operation consisted in exposing the injured pancreas and in drainage; eight times the operation was done late. After one or more weeks the hæmatoma arising from the pancreatic wound was opened and partly drained. Two cases died (those of Braun and Czerny) and six recovered (the cases of Rose, Mikulicz, Stern, Lissjanski, Michailow, Cushing, and Kuhlenkampf).

These figures include only the severe contusions of the pancreas in which the diagnosis was confirmed by autopsy or by an operation undertaken sooner or later. There is, therefore, no doubt that not infrequently slight contusions of the pancreas result from injury which either heal spontaneously or cause only minor disturbances. We must assume this possibility from experiments on animals. The cases in which traumata play an important rôle in the etiology of the different forms of acute and chronic diseases of the pancreas also teach us this lesson. This is especially the case in pancreatic cysts, of which about one-fourth are of traumatic origin, or, at least, referable to traumatic hæmatomata. Not every injury of the pancreas justifies a bad prognosis, nor does it warrant us in assuming that immediate recourse should be had to operative interference. The indication for operation does not only depend upon the diagnosis of an injury to the pancreas itself, but also upon the severity of all the symptoms, especially and particularly the steady accentuation of such symptoms. These symptoms are increasing anæmia, the physical signs of blood in the abdominal cavity, and peritoneal irritation. An injury to neighboring organs can frequently occasion the same symptoms, as I have previously stated, and, as a rule, it is not important to diagnose that the pancreas itself is injured. The diagnosis of an abdominal injury which can result in the death of a patient from hæmorrhage and peritonitis is in general sufficient. No definite rules can therefore be laid down as to whether one should await further developments or proceed immediately to laparotomy in any given case. The suspicion of a severe injury to the pancreas should encourage us to act quickly.

The figures previously mentioned, small as they are, teach us that severe injuries to the pancreas, which are not submitted to operation, terminate fatally almost without exception. They also teach us, in view of the favorable results obtained up to the present time, to make an exploratory laparotomy whenever there is a question of severe pancreatic injury.

We will now proceed to the inflammatory lesions of the pancreas.

A very excellent pathological classification of acute pancreatitis by Fitz has stimulated further research on the subject. That author divided pancreatitis into the hæmorrhagic, the suppurative, and the gangrenous varieties. This division is, however, not the best for the clinician. These three forms of pancreatitis, easily differentiated as they are in typical cases, merge into one another in most instances, or follow each other in succession. Even pancreatic apoplexy is very difficult to differentiate from hæmorrhage pancreatitis.

Furthermore, the acute and subacute forms of pancreatitis frequently border on chronic pancreatitis. I should, therefore, rather accept the classification of Robson from the clinical stand-point of acute, subacute, and chronic pancreatitis. The classification of Fitz into hæmorrhagic, suppurative, and gangrenous pancreatitis rather represents different stages of the disease, with a common etiology.

Let us now turn to acute pancreatitis, and first of all inquire if it is purely an infectious process, and whether it is exclusively the result of an invasion of bacteria. Without doubt, bacterial infection in acute pancreatitis plays an important rôle, but it does not alone explain the singularly severe symptoms. In this connection, the cases of genuine pancreatic apoplexy, which run their course as an acute hæmorrhagic pancreatitis, are of great importance. As is well known, a severe hæmorrhage from the pancreatic and retroperitoneal cellular tissue occurs in these cases, as the result of a peculiar dyscrasia of the patient, accompanied by hæmorrhagic peritoneal exudation, which is not of bacterial origin.* That a hæmorrhagic diathesis, or that other predisposing factors, as alcoholism, arteriosclerosis, syphilis, or fatty degeneration of the organ in obesity, play a great rôle, is not to be doubted, but does not explain the nature of the process. If we look for an analogous condition, we find it, as the term " apoplexy" expresses, only in the spontaneous hæmorrhages in the brain, but here the severe local reactions are missing.

There can be no doubt that there is in addition to the hæmorrhage some special cause for this phenomenon. We may not be amiss in attributing it to the action of the pancreatic and fat-splitting ferments upon the gland, which is the seat of an hæmorrhage or has been otherwise injured.

As a result of a slight blow, the following vicious circle may develop not only in those unusually rapidly fatal apoplexies, but also in small and harmless hæmorrhagic foci (of traumatic and non-traumatic origin): small hæmorrhages or disturbances in circulation (from arteriosclerosis, embolus, thrombosis); from this necrosis of a small area of the gland; infiltration around this focus of the ferments set free by the destruction of the parenchyma cells; digestive changes in the surrounding tissue and its vessels which were, until this time, unchanged; enlargement of the hæmorrhagic focus, partly as a direct result of the erosion of the vessels, and partly as the result of the undermining of the tissues and the increased pressure from the hæmatoma; necrosis and destruction of the surrounding parenchyma of the gland; further escape of the ferments, etc. The tendency to successive enlargement of all existing hæmorrhagic foci is present beyond doubt. It has already been mentioned in speaking of the difficulty with which traumatic hæmorrhage from even small vessels of this organ is controlled.

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* Hlava found that in so-called pancreatitis acuta, the hæmorrhagic exudate in the pancreas, as well as the peritoneum, was sterile. In medical literature the terms "' pancreatic apoplexy" and " acute hæmorrhagic pancreatitis" are frequently confounded, which can be explained by the great similarity of the clinical course as well as the anatomical findings in both affections. My opinion is that a sharp differentiation can only be based upon a bacteriological examination. The one is an aseptic, the other a septic process. The possibility of transitional forms lies in the fact that an infectious pancreatitis assumes a severe hæmorrhagic character as the result of a dyscrasia similar to that which we see in a pure pancreatic apoplexy.

Whether a primary focus involves only a small area and heals naturally; whether it slowly enlarges and later, after weeks and months, forms a pancreatic cyst, or finally gives rise to pancreatic apoplexy, depends on the resistance of the vessels and the interstitial connective tissue (fatty degeneration of this tissue is known to be a predisposing factor); upon the digestive activity of the escaping ferment, and, finally, upon the anti-fermentative property of the blood serum and the other body fluids.

I should like to emphasize the fact that in true pancreatic apoplexy, owing to the existing serious constitutional dyscrasia, a surgical procedure would hardly be warranted. As it is difficult, clinically, to distinguish these cases from cases of acute pancreatitis, it will occasionally happen to the surgeon to operate upon the former under a mistaken diagnosis.

If the pancreatic ferments play so important a part, even under aseptic conditions, we can readily understand their intensified action on the tissues when combined with bacterial infection. That these ferments are really of such importance in the development of acute pancreatitis is shown by the frequent occurrence of fat necrosis accompanying this disease. The characteristic features of acute pancreatitis are due, therefore, to the action of the pancreatic ferments.

The surgeon has little interest in the nature of the bacterial infection of the pancreas when the latter is only a part of a general systemic infection. Surgical interference is indicated particularly in those cases in which the pancreatitis is a purely local condition. This, according to our present knowledge, is very often the case. We know to-day, thanks to the researches of Robson, Opie, and Koerte, that the pancreatic duct, like the common bile-duct, is easily infected from the duodenum. The surgeon should always bear in mind that acute and also chronic pancreatitis often follows cholelithiasis and cholangeitis, as the infection travels from the bile-duct through the ampulla Vateri in a backward direction to the pancreatic duct. Opie has established the fact that a gall-stone can be caught in the ampulla Vateri and close it. Then under favorable anatomical conditions it can produce a retrograde flow of infectious bile into the ductus pancreaticus. Pancreatic calculi can of themselves cause a similar irritation. This, however, in contradistinction to gall-stones, seldom occurs.

The surgeon will accordingly bear in mind the following points in considering the etiology of acute pancreatitis:

1. The very slight tendency of pancreatic hæmorrhage to stop spontaneously.

2. The locally destructive and the general toxic action of the pancreatic ferments set free by the inflammatory and hæmorrhagic processes, and, finally,

3. The ease with which the pancreas may be infected from the ductus choledochus.

If these propositions are correct, I believe that the course of the surgeon, in order to master the situation, is clear.

We may consider acute pancreatitis as an acute phlegmon which, on account of the peculiar nature of the tissue, runs an unusually severe course. As in an ordinary phlegmon, so in the pancreas, the only rational therapy is to open the focus of infection with the knife and to empty and drain the toxic and infectious exudate. Gauze tampons will best combat the fatal tendency to hæmorrhage.

Of course, there are different degrees in the intensity of this process, just as in ordinary phlegmon, where we meet the most severe form of general sepsis as well as the most harmless furuncle. In such cases the surgeon will often refrain from operation when neither the general system nor important tissues or organs in close contact with the infected area are in danger of infection. But when the infection threatens to spread to vital organs, the surgeon will not dare to rely on spontaneous absorption or wait for the formation of a typical abscess. He must unhesitatingly proceed to lay open the focus of infection with the knife.

Such considerations, I should think, answer the question as to the expediency of surgical interference in the first,—the most acute stage of pancreatitis. We should not in general allow the severe symptoms to pass and delay the operation until the formation of an abscess.

To continue the comparison between acute pancreatitis and acute phlegmon, we can hardly conceive of a region in which the focus of infection could be more unfavorably placed. Not only is the patient threatened with severe toxic and general septic symptoms, but he is also exposed to the danger of a progressive general peritonitis. This is especially likely to develop in the subphrenic space, giving rise to subphrenic abscess. There is also the danger of formation of a phlegmon in the loose tissue of the retroperitoneal region, which is rich in lymphatics. From this, again, other complications arise, such as pyæmia, a phlebitis, or even a pleurisy. Most surgeons, even at the present time, are more or less opposed to early operation in acute pancreatitis, and clinical experience seems to justify their disapproval, for the results of early operation are not as good as those which follow later surgical interference.

Of the cases I have collected, only nine out of forty-six operated upon in the acute stage recovered. On the contrary, eighteen out of thirty-five recovered when the operation was done during the later stages of the disease. I believe, however, such statistics are of no great value.

First of all, we do not know, from statistics available at present, how many of these patients with acute pancreatitis really survive the acute stage and go on to the subacute, the most favorable stage for operation. I believe that comparative statistics in this regard will show that the great majority of the patients die in the acute stage. The possibility that a goodly number could be saved by means of a rationally conducted early operation cannot at the present time be denied. I say purposely "a rationally conducted" operation, for the operations done up to the present time for acute pancreatitis were not all rational procedures. As we know, most cases have been operated upon under a false diagnosis, and the disease has not even been recognized at the time of operation, the surgeon being compelled to close the abdomen without having relieved the condition of his patient. The post-mortem examination in these cases has first shown the true condition. The operation was usually done, a diagnosis of perforative peritonitis or intestinal obstruction having been made. The suspected perforation or occlusion was looked for; the operator thoroughly explored the abdomen; in many cases the intestines were eventrated, and finally the abdomen was again closed. As a rule, an anæsthetic had been given the patient. It is certain that by such procedures the patient was greatly harmed and not at all, or very little, helped. The evacuation of the hæmorrhagic peritoneal exudate alone was of some value.

Only in recent years, since surgeons have learned to recognize the ominous symptoms of fat necrosis and to refer them to an affection of the pancreas, they have ceased to make a thorough search among the abdominal viscera. Most surgeons to-day still close the abdomen when they have satisfied themselves of the existence of fat necrosis, in the conviction that the patient cannot be saved. Only a few surgeons are in favor of active and direct interference with the pancreas.

Nimier has proposed incising the pancreas in acute pancreatitis and introducing a tampon. Later on, Robson recommended early operation, making a small incision below the umbilicus, and, if necessary, a counter-incision at the border of the ribs for thorough drainage. In a similar manner, Lund recommends an incision above the umbilicus, splitting the gastrohepatic ligament, and thus securing free drainage of the omental bursa. When necessary, the vault of the diaphragm may be exposed, and drained by resection of the tenth and eleventh ribs.

I fully agree with these surgeons, for the reasons which I have previously mentioned. We should, at least, try such methods before admitting that we are powerless in all cases of acute pancreatitis.

The indication for laparotomy in these cases is more readily found by the surgeon, as he cannot in any given case make the differential diagnosis between an acute pancreatitis and other diseases calling for surgical intervention, such as acute perforative peritonitis and acute intestinal obstruction. He must in all such doubtful cases think of the possibility of acute pancreatitis. He will be able to make his diagnosis after opening the abdominal cavity and finding a hæmorrhagic exudate, upon determining the presence of fat necrosis, and by manual examination of the pancreas.

Having assured himself of these conditions, he should then proceed systematically, instead of terminating the operation at this time, as was formerly done. Cases of this kind, however, offer great difficulties, and we have yet to learn by experience which procedures will produce the slightest amount of surgical shock in the much-enfeebled patient, while still accomplishing the object for which they were undertaken.

In this connection, I will mention a case of Hahn's (*Deutsche Zeitschrift für Chirurgie,* Vol. lviii, page 1, 1901), in which that surgeon made an incision below the umbilicus, using local anæsthesia, and, after diagnosing an acute pancreatitis, confined himself to merely evacuating a large hæmorrhagic exudate and draining the abdomen with iodoform gauze. The fortunate issue in this case should encourage us to imitate this procedure in all those cases in which, owing to the weakened condition of the patient, it is inadvisable to explore the pancreas itself.

But Hahn's case is not the only one of its kind. As early as 1889, Halsted observed a recovery in a case of acute pancreatitis with fat necrosis of the omentum and mesentery where only a laparotomy and removal of peritoneal exudate were done. The operation was undertaken in the belief that the case was one of acute intestinal obstruction. Four years after operation a similar attack occurred in this patient.

Another case was operated upon by Pels-Leusden in 1901 in König's clinic under similar conditions and with a successful result. The peritoneal cavity was drained.

Finally, Henle, three years ago, operated upon a case in my clinic in which the diagnosis of acute intestinal obstruction had also been made. After demonstrating the presence of an extensive fat necrosis in the omentum, a large peritoneal exudate was removed. An artificial anus in the cæcum was established to relieve the condition of intestinal paralysis. The patient recovered and the artificial anus was closed six weeks later. In the course of the following year similar attacks recurred, but these were always less severe and subsided after high enemata.

This small number of favorable results does not allow us to draw binding conclusions regarding the efficiency of these operations. One could infer that the patients recovered not because of, but in spite of the operation. I believe, however, that even at the present time the following can be stated in favor of surgical interference:

1. The operation according to Hahn, under local anæsthesia, can be performed so easily that we can employ it even in collapsed patients without running any great additional risks.

2. Emptying of the peritoneal exudate and thorough flushing of the abdominal cavity with a 0.9 salt solution are surely of great benefit to the patient, more especially when the peritoneal cavity is later on drained.

3. An artificial anus, according to Henle, should be established only when intestinal paralysis exists.

Whether or not we will in future secure such favorable results with the methods already in use, as were obtained in the four cases of Halsted, Hahn, Pels-Leusden, and Henle, further experience alone will show. It must particularly demonstrate whether the simple operations, which do not directly include the pancreas itself, are sufficient not only to remove the symptoms of intoxication, but also to check the further development of the disease. *A priori,* one must consider an incision into the pancreas followed by drainage as a rational treatment in acute pancreatitis, even as in an acute phlegmon we make deep incisions to remove tension and expose the focus of infection, or as we open the medullary canal by trephining in the severe septic forms of osteomyelitis before the formation of real pus. The statistics up to date, in spite of these four favorable cases, as far as we may judge, show that an operation which does not disturb the pancreas, favorable as its influence may be on the general condition, does not help materially in combating this terrible disease.*

By active interference in the acute stage, we not alone desire to overcome the septic condition to which most of the patients succumb, but also to ward off necrosis and sequestration of large portions of the gland occurring in many cases. Even should the surgeon be able to remove the disintegrated portions of the gland, the loss of a considerable amount of pancreatic tissue might prove a serious matter to the patient later on. Among the cases of pancreatic necrosis which have been operated on with a favorable result, we find many in which the patients have succumbed to increasing emaciation and pancreatic diabetes from a loss of function of the gland.

So far I have considered only the case of acute pancreatitis, and, speaking generally, I have ventured the opinion that they should be subjected to surgical interference. As I have already stated, this seems to me eminently proper, as a differential diagnosis between acute pancreatitis and other diseases, which also demand immediate laparotomy, is hardly possible.

We must judge the *subacute* forms of pancreatitis somewhat differently. Cases occur in which the first fulminating attack disappears rapidly, or in which the disease begins insidiously at the outset, only gradually developing severe local and general symptoms. Here the surgeon has time to observe his case more carefully, and to consider the advisability of combating the attack without surgical interference; indeed, a delay in most of these cases is not inopportune, as the diagnosis is still more uncertain than in acute pancreatitis.

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* I have collected seventy-five operations for acute pancreatitis which were performed in the early as well as the late stages of the disease. Of thirty-seven cases in which the pancreas was involved in the operative interference, twenty-five recovered; in forty-one, where the pancreas was not touched, four cases recovered (the cases of Halsted, Hahn, Pels-Leusden, and Henle).

Chronic inflammations of the pancreas were not regarded as suitable for surgical treatment until a short time ago.

It was first shown by the observations of Riedel, Koerte, Lancereaux, and Hardin, and more especially by the careful work of Robson, Halsted, and Opie, that cases of chronic pancreatitis, which otherwise had seemed hopeless, were not only improved, but also completely cured by operative means. We have learned two things, above all others, in the last few years: first, that chronic pancreatitis runs a course not dissimilar to that of pancreatic carcinoma and has often been mistaken for the latter, and, second, that active interference has often been postponed because we have been unable, as just stated, to properly recognize the condition of chronic pancreatitis, and have confounded it with a condition beyond surgical relief. It is easy to understand how the clinical symptoms of both affections, especially in disease of the head of the pancreas, could show a resemblance. But even after opening the abdomen, the differential diagnosis can often not be made by palpation, since in both cases the diseased portions of the pancreas present a hard, irregular mass enclosed in the gland. Only recently, in a case of that nature, with closure of the common bile-duct by the indurated head of the pancreas, I did a cholecystentero-anastomosis in the belief that I was dealing with a carcinoma. When the patient died ten days later of pneumonia, I learned from a microscopical examination that I was dealing with a case of chronic pancreatitis. In several other cases, during my earlier experience, I have made a diagnosis, with or without operation, of carcinoma of the pancreas, and have in consequence given an unfavorable prognosis. In these cases the patients have recovered. The diagnosis should, of course, have been chronic pancreatitis.

Another no less important point, to which Koerte, Robson, and Opie have called attention, is the close relation existing between chronic pancreatitis and diseases of the biliary tract.

Gall-stones which become impacted near the papilla Vateri, even though small, have an important bearing upon the development of chronic as well as acute pancreatitis. Infection arising from a cholangeitis may spread through the pancreatic duct to the pancreas. On the other hand, a chronic pancreatitis of the head of the pancreas can easily simulate a cholelithiasis by compression of the common bile-duct.

From what has been said, it is evident that chronic pancreatitis must always be considered in making a diagnosis of cholelithiasis; and, further, that with gall-stones and cholangeitis, especially when the common duct is involved, one must be prepared to find a lesion also of the pancreas.

Barring the cases of chronic pancreatitis already discussed, pancreatic calculi are found only in very exceptional cases.

The surgeon should always bear in mind the possibility of a pancreatitis developing as the result of a chronic intoxication (alcohol) analogous to the development of cirrhosis of the liver.

Owing to the uncertainty of the diagnosis of these conditions, an operation should always begin as an exploratory incision. Only after establishing the diagnosis on a firm basis, by local examination, is the surgeon enabled to further develop his plan of operation. He must choose between two ways: he must strive to remove the cause of the disease; this he will do when he finds impacted concretions in the common bile-duct, the papilla Vateri, or Wirsung's duct. The technique of all these operations is not unlike that of cholelithiasis.

As impacted calculi generally give rise to an infectious cholangeitis or an inflammation of the pancreatic duct, drainage, as a rule, of one or both ducts must be provided. One should also drain the neighboring portions of the peritoneal cavity with tampons.

The second way is more indirect, inasmuch as only a free outlet for the confined and infected bile is established. This can be done through a gall-bladder fistula by means of a cholecystotomy when the cystic duct is free, or by establishing a communication with the small intestine by means of a cholecystenterostomy. Both operations have their advantages and disadvantages.

The technique of the first is more simple, and does not permit a permanent infection of the bile-tract from the contents of the intestine. It has the disadvantage that the patient is burdened for a long time with an external fistula, the closure of which may prove difficult. The question as to which of these two operations is preferable has not yet been answered by clinical experience. I want, however, to emphasize that the importance of a retrograde infection of the bile-tract from the intestinal fistula is by no means so great as it may at first appear; this, at least, the experimental work of Radziewski, done in my clinic, would indicate.

The danger of infection is greatly diminished when the plan which I recommended in these cases is employed. After cholecystenterostomy an entero-anastomosis is immediately added at a distance of about ten centimetres from the original anastomosis, which deflects the intestinal circulation from the loop in connection with the gall-bladder.

I should also recommend that the surgeon do not hesitate too long in operating for chronic pancreatitis, as severe disturbances of nutrition can occur following gradual degeneration of the organ. Of course, when only mild symptoms are present, one will not resort to the knife at once, but rather recommend internal medication.

The results of operation at present in chronic pancreatitis are very encouraging. If I include twenty-two cases of Robson, in which there was only one death in connection with the operation, I find thirty-six cases reported, of which thirteen recovered and five proved fatal.

One can treat the subject of surgical interference for pancreatic calculi very briefly, as they are known to be very rare, and, consequently, no very detailed accounts of the experience of surgeons with them are available. I find reports of two cases, both of which died following operation. In one of them the stones were removed from the head of the pancreas and the ductus Wirsungianus. In the second a cholecystentero-anastomosis was done, as a diagnosis of pancreatic calculi was not previously made.

Since a pancreatic stone does not give rise to any characteristic symptoms, and is only recognized as such when passed in the fæces, the surgeon is only concerned with the secondary changes which its presence may cause. These will arise from a blocking of the pancreatic duct or its branches, and will become evident from an accompanying chronic or subacute pancreatitis. The surgeon will find an indication for interference only if symptoms of pancreatitis are present. In all such cases, therefore, we should also remember the possibility of the presence of calculi.

I will now briefly give my personal experience in the field of pancreatic surgery. The thirty cases in which I have had the opportunity of operating upon the pancreas while performing a resection of the stomach for cancer, I have already considered.

Besides these, during the twelve years that I have been in Breslau, I have operated on the pancreas thirty times; ten of these were typical pancreatic cysts, of which two were removed and eight were incised and drained. All recovered.

A subacute pancreatitis occurred twice among these cases, once leading to abscess formation and the second time giving rise to fat necrosis. The abscess healed after incision. The other patient was the one before mentioned as the case of Dr. Henle, who was restored to health after a preternatural anus had been established. He was successfully operated upon without disturbing the pancreas. A case of chronic pancreatitis, also previously mentioned, died of pneumonia ten days after a cystentero-anastomosis. In a case which was mistaken by me for carcinoma, the patient lived four years after the laparotomy.

In one case of contusion of the pancreas, the result of blunt force, twenty-four days after the lesion, an immense hæmatoma was opened and drained. The case recovered. This case was also mentioned before.

I have observed fifteen malignant growths involving the pancreas. In these exploratory laparotomy was done seven times and cholecystenterostomy five times. Of the latter, one died as a result of the operation.

Once a gastro-enterostomy was done for a stenosis of the duodenum due to a pancreatic tumor.

Once drainage for a softened tumor which was taken for a cyst was made, and

Once extirpation of a tumor in the head of the pancreas was done. All three cases ended fatally.

Post Scriptum.—A week after I had read my paper before the Congress at Washington, I had the privilege of seeing a case of acute pancreatitis in the Massachusetts General Hospital in Boston, which had been operated on by Dr. C. A. Porter with an excellent result. In this case, for the first time to my knowledge, multiple deep incisions were made into the substance of the pancreas, to relieve tension, in the manner which I have suggested in the present paper. As this case marks the first practical application of a definite surgical principle in acute pancreatitis, I take the liberty of adding a history of the same, as kindly furnished me by Dr. Porter.

S. P., aged thirty-six years, salesman, entered the Massachusetts General Hospital, February 17, 1903, as a patient of Dr. C. A. Porter.

History.—Patient had previously entered the hospital on October 30, complaining of dull pain in the right hypochondrium for the past seven years, and chronic constipation. A year ago, he was seized with sharp pain in the epigastrium, which later localized itself in the right iliac fossa. The pain was constant and very severe. No vomiting, no chill; had never been jaundiced. Examination at that time showed the abdomen to be tender, especially in the region of the gall-bladder, where there was some rigidity. Under rest in bed, in five days the patient was discharged relieved, to report again.

From November 5 until re-entry on February 17, patient had had several attacks of severe pain in the upper abdomen and right hypochondrium. A month ago he had slight jaundice, and a diagnosis of gall-stones was made. On February 15 patient suffered from a sudden and severe abdominal pain in the epigastrium and right iliac fossa, was nauseated, but did not vomit. Morphine gave relief. Pain continued, and has steadily increased; is now general throughout the abdomen, somewhat more marked in the right hypochondrium and flank. Last night patient began to vomit, and this has become continuous. Bowels moved once after an enema.

Examination showed a somewhat emaciated man, evidently in great pain and distress. Skin was moist, slight dyspnœa. Patient is vomiting continuously, thrashing about in the bed. Vomitus, brown, sour-smelling, not fæcal, no blood. Abdomen moderately distended. Greatest pain referred to the right costal border and epigastrium, next to the right iliac fossa. No visible peristalsis. Rigidity moderate. Less marked in the epigastrium and the right iliac fossa. Deep pressure in the latter region causes pain and increased rigidity. Examination of epigastrium impossible, owing to rigidity. Abdomen tympanitic in centre, flat in both flanks, dulness shifts readily, therefore free fluid is present. Temperature, 100° F.; pulse, 100, of poor quality; respiration, 30; leucocytosis, 8000. At the time, a diagnosis was made of probable intestinal obstruction from a band in connection with an old inflammatory process about the gall-bladder or appendix.

Ether was given, and a median incision from three inches below the ensiform cartilage to two inches above the pubis, through the right rectus muscle. On opening the abdominal cavity, large amounts of brownish, red fluid emerged. This fluid was clear, and evidently colored by blood. Culture made reported sterile. The intestines were everywhere injected. No tumor or band could be found, and no especially distended coils of intestine. Examination of the appendix showed that it was large and injected, but not gangrenous. Disseminated throughout the abdomen were numerous areas of fat necrosis, which varied in size from a pinhead to a split pea. The fat necrosis in the meso-appendix was especially well marked. The appendix was removed.

Examination of the gall-bladder showed a few adhesions, and that it was slightly distended with bile. Examination of the pancreas showed it to be enlarged to three times its normal size, very hard and tense. After thorough irrigation of the abdomen with salt solution, the median incision was closed, and an incision along the left costal margin, five inches long, made. With deep retractors the ribs were held upward, the small intestines and stomach were packed with gauze upward, and towards the median line. Examination of the pancreas was made through the mesentery of the transverse colon. From the spleen to the duodenum the pancreas was very large, tense, and œdematous, of a deep purplish color. No stones could be felt in the duct. It seemed evident that the diagnosis of acute pancreatitis required proper drainage, therefore an incision was made through the mesentery from the median line to the tail of the pancreas. This incision was about four inches long and three-quarters of an inch deep. Several areas of fat necrosis were found in the peripancreatic tissue. A rubber tube was placed up to the pancreas, and all of the intestines were carefully walled off with gauze sponges.

Recovery after operation was rapid. Vomiting stopped, the patient had far less pain, there was no fever, no increase in the white count, and the pulse soon fell to 80. At the end of a week the gauze was changed, and the wound appeared healthy. On the twelfth day, two small pieces of gangrenous fat tissue came away. The gauze was changed three times a week, and the wound rapidly granulated and healed. Throughout the convalescence, the leucocytosis never rose above 10,000. There was no distention, the bowels moved normally.

Urinary examination showed interesting conditions. Immediately after the operation, a slight trace of albumen, with granular casts. On the 23d of February, bile in large amount, few casts, also 1.4 per cent. of sugar. On the 26th, sugar was absent, albumose present in small amount. By March 2, the urine was normal, except for an increase of indoxyl and kreatinin. Numerous experiments were made with salol, feeding with a large amount of grape sugar, etc., and investigation of the stools for undigested fat. All of these tests showed nothing abnormal.

On April 1, the patient was up and about, and had gained much in color and general health. Convalescence seemed perfect.

About the middle of April, however, he complained from time to time of pain in the epigastrium, above the umbilicus. There was no fever, no increase in leucocytosis. The bowels had not been acting very well.

In view of the persistence of this pain, it seemed wise on April 17 to operate again, in order to find out whether a stone were impacted in the common duct, and if none were found, it was planned to drain the gall-bladder. On April 17, a five-inch incision was made along the outer border of the rectus muscle, from the rib margin downward. On opening the cavity, adhesions were discovered between the omentum and the anterior abdominal wall. The gall-bladder was found to be much thickened, but not distended. Numerous adhesions about it showed evidence of an old inflammation. The duodenum was separated from behind; with one finger in the foramen of Winslow and another behind the duodenum, the whole biliary passages were examined. No stones could be felt, but the common, cystic duct, and gall-bladder were markedly thickened. The pancreas had again resumed its normal size and feel, except in the head, where some induration was present. No evidences of fat necrosis had remained behind. Finally, it seemed best to make a small incision by tearing between the stomach and the transverse colon. With one finger in the lesser peritoneal cavity, and the others behind the duodenum and pancreas, careful palpation revealed a slightly fluctuating area in the head of the pancreas, about two centimetres in diameter. This was incised through the lesser peritoneal cavity, and a teaspoonful of broken-down débris evacuated. Cultures from this were sterile. A finger-tip placed in the cavity could feel no stone. This cavity was curetted clean and packed with gauze. The gall-bladder was sewed to the anterior abdominal wall, but not opened. A wick was inserted under it to drain the space rooted up by the freeing of the duodenum.

Convalescence from this operation was complicated by pneumonia in the right base, with much foul, purulent sputum. The temperature rose to 103° F., but fell to normal six days after operation, from which time convalescence has been uninterrupted. On May 20, the patient was discharged with a very small sinus in the wound. Owing to freedom from pain, the gall-bladder has never been opened. No sugar or abnormal urine constituents could be found after the second operation. Patient has gained ten pounds in weight.